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By Sir LAUDER BRUNTON, M.D., F.R.S.

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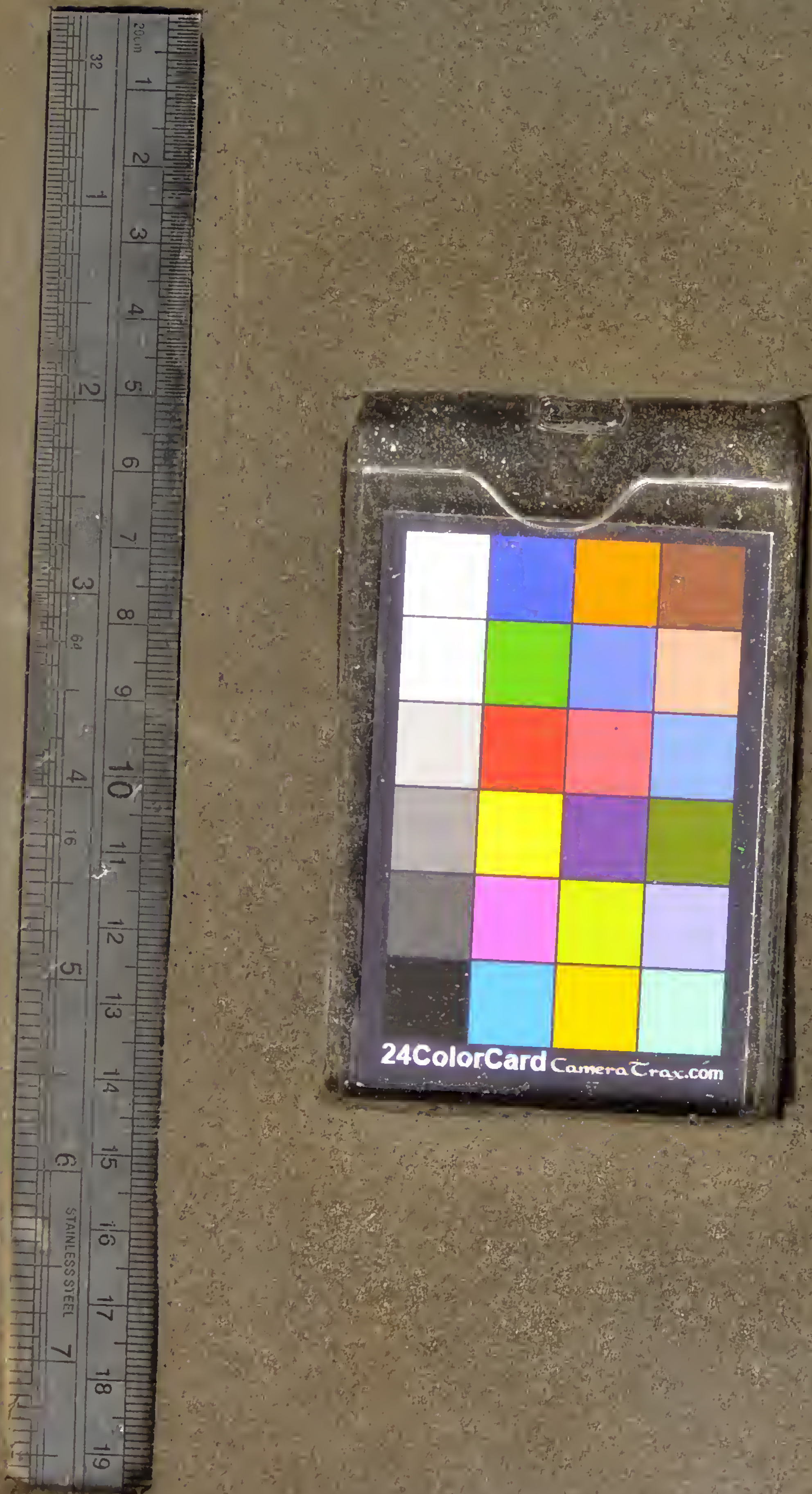
At the meeting of the Physiological Congress in Cambridge, two years ago, I demonstrated an experiment by which the clumping of bacilli and the formation of rouleaux by the blood corpuscles could be readily illustrated and possibly explained.[1] I did not, however, publish a description of the experiment at the time, and I think it may be advisable to do so now, as it may illustrate and explain the causation of the two phenomena just mentioned. The experiment consists in covering lucifer matches with hard soap, and throwing them into water contained in a large flat trough, such as is used for photographic purposes, or for sterilising surgical instruments. A trough about 1½ in. deep, 8 in. long, and 12 in. broad, answers very well, although, if the experiment has to be demonstrated in a large lecture room, a larger trough should be employed. It should be filled to half its depth, or more, with water, coloured blue with litmus. If the artificial bacteria be now thrown into the liquid they float about indifferently, but if the water be acidulated they at once draw together into clumps, the acidulation of the water being rendered evident by change of colour in the litmus from blue to red. If a solution of caustic potash be now poured into it, the red colour will disappear from the litmus as the reaction of the fluid becomes alkaline, and at the same time the clumps, if stirred with the finger, readily break up and will not re-form. Blood corpuscles may be imitated by cutting slices about $\frac{3}{16}$ in. thick from corks, but this may be done still more readily by cutting discs out of sheet cork of about $\frac{3}{16}$ or ¼ in. thick, by means of a cork borer ¾ in. in diameter. These should be loaded at one side by cutting a hole about $\frac{1}{6}$ in. in diameter with a small cork borer, and putting into this a swan-shot, or a piece of the right size and length cut off a rod of lead. By striking this on each side it can be riveted so as to remain in position. By proper adjustment of the thickness of cork and the amount of lead, the artificial blood corpuscles may be made to float upright in

[1] While this paper was in the press I demonstrated this experiment to the Physiological Section of the Thirteenth International Medical Congress in Paris.

the water, and either to remain partially or totally submerged. This method of imitating the formation of rouleaux by blood corpuscles artificially is due to the late Professor Norris of Birmingham, who, in a paper read before the Royal Society, 27th May 1869, showed that artificial blood corpuscles partially submerged quickly run together and form rouleaux. If totally submerged they remain indifferent, and do not seem to attract one another. If, however, they are dipped in petroleum, so that they are not wetted by water, they run together even though they are submerged. These facts are no doubt due to alterations in surface tension. It occurred to me that if the cork discs were covered with soap, so as to be readily wetted by water, they would remain indifferent, but if the water were acidulated the surface of the coating of soap would be decomposed, and a thin layer of fatty acid formed, which would not be wetted by the water; and the corpuscles would tend to form rouleaux, exactly as though they were wetted with petroleum, as in Norris' experiment, and on testing this I found the corpuscles behaved exactly as I had expected. On trying the same thing with wooden matches, to imitate bacteria, I found that they behaved like the artificial corpuscles, with this difference, that they formed clumps instead of rouleaux. From this experiment it seems probable that the formation of rouleaux by the red blood corpuscles and of clumps by bacteria is due to some slight alteration in their surfaces, and this may not improbably be due to the liberation of some fatty substances by means of carbonic acid. In the case of typhoid bacilli the formation of clumps is a complex phenomenon, depending first on the death of the flagella which render the bacilli motile, and thus tend to keep them apart, in spite of any addition to their surfaces; and, second, to alteration in their surface tension, which tends to produce clumping. It is not improbable that the presence of carbonic acid may have a good deal to do with the formation of rouleaux by blood corpuscles and with the clumping of bacilli.

Some tight gutters.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